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RESOURCE USE EFFICIENCY AND CONSTRAINTS IN PRODUCTION AND MARKETING OF TISSUE CULTURE AND SUCKER PROPAGATED BANANA

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ABSTRACT

The present study was based on primary data and collected from selected farmers to estimate the resource use efficiency and constraints in production and marketing of tissue culture and prorogated banana in Uttar Pradesh. Result of study shows that the value of coefficient of determination (R^2) and returns to scale were 0.86 and 0.625 respectively for sucker prorogated banana production while for tissue culture prorogated Banana, the value of coefficient of determination ($R^{2)}$ and returns to scale were found 0.46 and 0.37 respectively. Result also shows that technical, allocative and economic efficiencies were higher in case of sucker propagated banana compare to tissue culture banana. The technical, allocative and economic efficiency of sucker propagated banana were 79.40, 69.30 and 55.02 respectively. Similarly in case of tissue culture banana they were 75.80, 55.60 and 42.14 respectively. Non availability of labour in sufficient quantity at correct time was the major problem identified both in sucker and tissue culture banana production. Lack of market for banana nearer (distant market) to farm or village was major problem felt by the farmer, Lack of regulated market, Non availability of proper storage facilities and lack of grading and packaging. High cost of planting material was a severe problem in tissue culture banana. The fluctuation in the market prices, distant location of regulated markets and lack of grading and packaging of the produce were also some identified problems in the study area.

KEYWORDS: MVP, Resource Use Efficiency, Cobb-Douglas Production Function, OLS, Regression and T Test

INTRODUCTION

Agriculture is the backbone of our country and has a prime role in Indian economy. This sector provides livelihood to about 65 per cent to 70 per cent of the labour force agriculture not only provides food for growing population but also contributes around 14.60 percent ages of country's GDP with tremendous domestic and export potential (Meena, *et al.*, 2014; Kumari *et* al., 2015; Dubey *et al.*, 2008). India is the second largest producer of fruits (75.82 million tonnes) after China (122.184 million tonnes) and ranks first in production of mango (39%), banana (29%), papaya 38%), limes and lemon. Banana is the main fruit in international trade and the most popular one in the world. Banana is a globally important fruit crop with 99.99 million tones of production in the year 2010-11. In case of Bihar, Banana is grown over an area of 31.9 thousands ha and production is 1517100 MT and The productivity 47.6 MT/Ha in the year 2010-11. Banana is important fruit grown in the state, ranks 7th in area and yield and 6th in production in country (Govt of Bihar 2012).

Tissue culture banana production technology is a superior technology over traditional method (Sucker-propagated) of banana production with respect to optimal yield, uniformity, disease free planting material and true to type plants. Mass multiplication of tissue culture plants could be done in a short time. According to the Food and Agriculture Organization (FAO) estimations, world total exports of banana accounted for 15.9 million tonnes in 2004 (Anonymous, 2011). Banana is also a very important staple food for many developing countries for their food security. It is one of the most important major fruit crops grown in India. In respect of area banana ranks third and first in production only after mango and citrus. India leads the world in banana production with an annual output of about 29.78 million tonnes from 0.83 million ha with an average productivity of 35.9 tonnes per ha during the year 2010-11 (Anonymous, 2011) and it supports livelihood of million people. Major fruits grown in the state are Mango, Litchi, Banana, Guava, Pineapple, Citrus, Papaya and Ber. Khagaria district of Bihar has been identified for Tissue culture Banana plantations

Due to population expansion, higher purchasing power and development of new markets, demand for banana is increasing at a faster rate. As a result of high demand and practice of replanting gardens once in 2-3 years, the demand for new planting material is increasing at a rapid rate. Most of the forms of banana are seedless, sterile and conventionally propagated by suckers. Even though natural rate of suckering is reasonably high (5-10 per year). Tissue culture banana production technology is a superior technology over traditional method (Sucker-propagated) of banana production with respect to optimal yield, uniformity, disease free planting material and true to type plants. Mass multiplication of tissue culture plants could be done in a short time. Therefore, an attempt is made in present study to compare the performance of tissue culture banana production technology with traditional method of banana cultivation both from production and marketing angle. Hence the present study was carried out to estimate resource use efficiency and to identify constraints in production and in banana production.

RESEARCH METHODOLOGY

To study the resource use efficiency and constraints in production and marketing and suggestions, the data were collected by personal interview from farmers of Khagaria district with the help of structured and pre-tested schedule. Two blocks namely Parbatta and Gogri were selected**.** Three villages from each selected block, namely Kulharia, Karna, Kaela in Parbatta block and Gouchari, Pasraha, Ghitkia in Gogri block were selected for study.

Analytical Tools

Cobb-Douglas Production Function

The specific Cobb-Douglas type of production function used for estimating Resource Use Efficiency (Reddy, *et. al*., 2005)

$$Y = a.x_1^{b1}x_2^{b2}x_3^{b3}x_4^{b4}x_5^{b5}e^{u} \quad (1)$$

Where,Y= Output of banana. (Tonnes / per ha.)

α= Intercept, (a scale parameter)

X_1 = Number of suckers/plantlets used (No / ha.)

X_2=Quantity of FYM and fertilizer used (Rs. /ha.)

X_3= Organic manure (Rs. / farm)

X_4= Human labour (man days / ha.)

X_5= Machine labour (hours / ha.)

e^u =Error term

b_i= Output elasticity of respective inputs. The summation of these give returns to scale.

The logarithmic transformation takes the linear form; the parameters were estimated using the Ordinary Least square (OLS) method.

$$\text{In } Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_{5\ +u} \ln_e \quad (2)$$

The regression coefficient thus obtained were tested for their significance using the t-test

The Formula used for the T-Test was

$$t = b_i \text{ SE } (b_i) \quad (3)$$

Where, b_i is the regression coefficient of the independent variable, SE (bi) is the standard error of the regression coefficient b_i, t is calculated 'value. Adjusted R^2 (the coefficient of adjusted multiple determination) was computed to test the goodness of fit of the model.

Estimation of Marginal Products and Marginal Value Products

In order to determine whether a particular resources used optimally, the marginal value product and opportunity cost of one unit of that resource were compared.

Timmer's Measure of Technical Efficiency

It is the ratio of actual gross return to the potential gross return on the production function given the level of input use on the i^{th} farm.

Technical efficiency of $i^{th\ farm} = Y_i / Y_i^*$

Where Yi is actual gross return from crop cultivation on i^{th} farm, Y_i^* is the potential gross return attainable from crop cultivation on i^{th} farm for most efficient farmer (Y = Y*) the technical efficiency will be highest i.e. = 1.

Allocative Efficiency

$$\text{Allocative efficiency} = VMP_{Xi}\, MFC_{Xi} \quad (4)$$

$$VMP_{Xi} = \beta_i Y_i X_i \quad (5)$$

Where, VMP_{Xi} = Value marginal product of i^{th} input, β_i= Input co-efficient of i^{th} input, $\overline{Y_i}$ =Geometric mean of gross returns of i^{th} input, $\overline{X_i}$ =Geometric mean of input of i^{th} input

Economic Efficiency

Economic efficiency (EE) is the product of technical efficiency (TE) and allocative efficiency (AE)

$$EE = TE * AE \quad (6)$$

Constraints Faced by Irrigated Farmers

The constraints faced by the banana growers were calculated by subjecting the opinion of farmers regarding the constraints to relevancy rating and ranking of the same according to their importance. The farmers were asked to rate the constraints on a five-point relevancy continuum viz., 'not at all', 'low', 'moderate', 'high' and 'severe'. Relevancy coefficient (RC) of i^{th} constraint was worked out by using the formula.

$$RC_i = \frac{\text{Total score of all the respondents for } i^{th} \text{ constraint}}{\text{Maximum on the continuum} \times \text{Total number of respondents}} \quad (7)$$

The ranking of each constraint was made according to its relevancy coefficient such that the constraint having the highest relevancy rating is ranked 1^{st} and subsequent rank given according to the scores obtained in that order.

RESULTS AND DISCUSSIONS

Resource Use Efficiency in Sucker Propagated Banana Production

Table 1: Cobb-Douglass Production Function Estimates and MVP To MFC Ratio in Sucker Propagated Banana Production

S. No	Particulars	Parameters	Respective Value	Mvp	Mfc	Mvp/ M Fc
1.	Intercept	A	-1.21			
2.	Suckers(X_1)	b_1	0.13	1.30	2.51	0.51
3.	FYM and Fertilizers (X_2)	b_2	0.35*	1.72	1	1.72
4.	PP chemicals(X_3)	b_3	0.01	1.61	1	1.61
5.	Human labour(X_4)	b_4	0.07**	1.10	57.25	0.01
6.	Machine labour(X_5)	b_5	0.048	-6.35	250	-0.02
		R^2	0.86			
		Return to scale	0.62			

The results of regression analysis in the production of sucker propagated banana are presented in Table 1. It could be seen from the Table that the regression co- efficient of sucker (0.13) was not significant and the MVP (Marginal Value Product) to MFC (Marginal Factor Cost) ratio was 0.51. The regression coefficient of FYM (farm Yard Manure) and fertilizers (0.35) was significant at 5 per cent and the MVP to MFC ratio was 1.72. The regression coefficients of plant protection chemicals and machine labour were non-significant and their MVP to MFC ratio was 1.61 and -0.025 respectively. The regression coefficient of human labour (0.078) was significant at1percent and the ratio was 0.019. The R^2value was0.86.The returns to scale were0.625.

Resource use Efficiency in Tissue Culture Banana Production

Table2: Cobb-Douglass Production Function Estimates and MVP To MFC Ratios in Tissue Culture Banana Production

S. No.	Particulars	Parameters	Respective value	MVP	MFC	MVP/M FC
1.	Intercept	a	1.65			
2.	Suckers(X_1)	b_1	0.09	19.53	11.22	1.74
3.	FYM and Fertilizers (X_2)	b_2	-0.04	3.47	1	-3.47
4.	PP chemicals(X_3)	b_3	0.02	2.19	1	2.19
5.	Human labour(X_4)	b_4	0.12	60.93	62.5	0.96

Table 2: Contd.,						
6.	Machine labour (X_5)	b_5	0.08	232.3	250.0	0.92
		R^2	0.46			
		Returns to scale	0.37			

The results of regression analysis in the production of tissue culture banana are presented in Table 1.Itcould be seen from the Table that the regression co-efficient of plantlets was (0.091) significant at 5 percent level and the MVP to MFC ratio of which was1.74. The regression coefficients of FYM and fertilizers was (-0.042) and non-significant and the MVP to MFC ratio was-3.4703. The regression coefficients of plant protection chemicals, human labour and machine labour were significant at1 percent level and their respective MVP to MFC ratios were 2.19, 0.96 and 0.92 respectively. The R^2 value was 0.46 with 0.37 returns to scale.

Technical, Allocative and Economic Efficiency of Resources in Banana Production

The technical, allocative and economic efficiency of resources in production of sucker and tissue culture banana are presented in the Table 2. The Table reveals that, all technical, allocative and economic efficiencies were higher in case of sucker propagated banana compare to tissue culture banana. The technical, allocative and economic efficiency of sucker propagated banana were 79.40, 69.30 and 55.02 respectively. Similarly in case of tissue culture banana they were 75.80, 55.60 and 42.14 respectively.

Constraints in Production and Marketing of Banana

The farmers were interviewed to elicit the problem faced by them relating to various aspects of production and marketing of banana.

Production Constraints

Table 3: Production Constraints of Banana Growers in the Study Area

S. No	Constraints Faced by Farmer	Sucker Banana N=30	Tissue Culture N=30
I	**Production Constraints**		
1	Non availability of genuine planting martial in time	8(26.33)	16(53.33)
2	Non availability of high yielding variety of banana	3(10.00)	1(3.33)
3	Non availability of fertilizer	17(56.66)	18(60.00)
4	Lack of irrigation facilities	13(43.33	14(46.66)
5	Non availability of labour in time	17(56.66)	24(80.00)
6	Others		
	a) High cost labour supply	27(90.00)	13(43.33)
	b) Destruction due to high wind	26(86.33)	20(66.66)
II	**Technical Constraints**		
1	Lack of knowledge culture banana production.	22(73.33	15(50.00)
2	Lack of knowledge about fertilizer application.	21(70.00)	14(46.66)
3	Lack of knowledge about planting material treatment	25(83.33	16(53.33)
4	Lack of knowledge about identifying the disease.	27(90.00	23(76.66)
5	Lack knowledge about identifying pests.	26(86.66)	21(70.00)
6.	Other (Lack of knowledge about plant protection)	27(90.00)	24(90.00)

Opinion of cultivators on different aspects of banana production is presented in Table 3. Non availability of labour insufficient quantity and at correct time was the major problem identified both in sucker and tissue culture banana production. 90 percent of sucker banana farmers and 80 percent in tissue culture banana farmers were expressed this problem, Inadequate

irrigation water especially in summer days was the other major problem felt by the producer, Destruction of plants due to high wind in the months of May, June and July was the other problem, inadequate supply of irrigation water, Non availability of genuine planting material, Lack of knowledge about identifying the pests, diseases and knowledge of plant protection, Lack of perfect knowledge about tissue culture banana production.

Marketing Problem

Table 4: Marketing and Economic Constraints Faced by Farmers in the Study Area

S. No.	Constraints Faced by Farmer	Sucker Banana N=30	Tissue Culture N=30
I	**Marketing Problems**		
1`	Lack of transportation facilities	3(10.00)	1(3.33)
2.	High cost of transportation	25(83.33)	27(90.00)
3.	Fluctuation in market prices	18(60.00)	10(33.33)
4.	Absence of regulated markets	30(100.00)	30(100.00)
5.	Distant market	30(90.00)	30(100.00)
6.	Lack of grading and packaging	26(86.66)	14((46.66)
7.	Lack of storage facilities	30(100.00)	30(100.00)
8.	Un-even payment for sale after sale	18(60.00)	23(76.66)
II	**Economic Constraints**		
1.	High cost of planting material	2(6.66)	26(86.66)
2.	High cost of transport in planting material	4(13.33)	3(10.00)
3.	High cost of pesticides	24(80.00)	22(73.33)
4.	High cost of labour	28(93.33)	17(56.66)
5.	Non-availability of credit in time	8(26.66)	12(40.00)
6.	In adequate credit facility	2(6.66)	3(10.00)
7.	High cost of barrowing	7(23.33)	9(30.00)

The problems faced by the farmers in marketing of banana are presented in the Table 4. In reality there is was no such difference in marketing of banana between sucker and tissue culture banana. Lack of market for banana nearer (distant market) to farm or village was major problem felt by the farmer, Lack of regulated market, Non availability of proper storage facilities and lack of grading and packaging, High cost of transportation charges and delayed payment for the produce sold, Fluctuation in market prices of the produce were the severe problem in marketing of banana.

Financial Constraints

High cost of planting material was as every problem in tissue culture banana, High cost of pesticides and high cost of labors, High cost of borrowing in adequate credit facilities and non-availability of credit in time were not found to be major problems in banana production.

Marketing Problems

The major marketing problems in production of sucker banana in the study area are presented in the Tables 4.The fluctuation in the market prices, distant location of regulated markets and lack of grading and packaging of the produce were also some identified problems in the study area. The delayed payment for sale and inadequate transportation were not major problems.

DISCUSSIONS

The costs and returns of Poovan cultivar banana production in Thrichirapalli district of Tamil Nadu, over a period of three years. Total cost of cultivation per hectare was Rs. 1, 24,668.11, with the gross income of Rs. 2, 86,913.80 and there by the net income worked out to be Rs. 1, 62,235.69 per hectare. The study clearly showed the high profitability of verity Poovan banana with a high benefit cost ratio 2.3: 1 in the study area (Senthilathan and Srinivasan, 1994). The average output per hectare was 40.29 tonnes valued at Rs.71, 743.32 per hectare, gross returns ranged from Rs. 69,894.78 on large farms to Rs. 74,521.59 on small farms. Per hectare profit at cost 'C' for the sample as a whole was Rs.19,533.79 and it ranged from Rs. 17,685.20 in large size group to Rs. 18, 557.48 in small size group (Dhakate,1996). studied the economics of production marketing of banana in Marathawada region of Maharashtra state, he found that the cost of cultivation of banana per hectare was higher on small farms (Rs. 32,294.72) compared to large farms (Rs. 76,610.06) due to inefficiency in utilization of bullock labour, machine labour, human labour and manure and fertilizer in case of large farmers. The gross income per hectare was higher in large farmers (Rs. 1, 42,885.30) compared to small farmers (Rs. 1, 40,696.80) due to higher yields in large farmers (More, 1999).

Economics of banana cultivation and its marketing in Haveri district of Karnataka, reported that the variable cost incurred by producer was Rs. 54,502.81 per hectare which was accounted to 65 per cent of total cost. Among variable costs, the human labour was found to be the major item of cost, which accounted for 18 per cent. On an average farmers got 175 quintals of banana yield as main product valued at Rs. 1, 54,375 and farmers have realized Rs. 30,000 by selling suckers; the gross returns from banana cultivation were Rs. 1, 84,375 per hectare. The net returns realized by farmers were Rs. 1, 00,545.96 with a B: C ratio of 2.19 (Guledgudda *et al.,* 2002). Economics of production and marketing of banana in Jalgaon district of Maharashtra. The worked out cost per hectare of banana cultivation was Rs. 1, 33,477.36, the gross returns per hectare of banana at Rs. 2, 14,867.24 and net returns at Rs. 6, 67, 61.87 (Mali *et al.,* 2003).

CONCLUSIONS AND POLICY IMPLICATION

Tissue culture banana production technology is a superior technology over traditional method (Sucker-propagated) of banana production with respect to yield, uniformity, disease free planting material and true to type plant production. Mass multiplication of tissue culture plants could do in a short time. Resource use efficiency analysis revealed that, in case of sucker propagated banana the regression co-efficient for sucker was 0.135 but non-significant and the (Marginal Value Product) to (Marginal Factor Cost) ratio was 0.51. The regression coefficient for FYM (farm Yard Manure) and fertilizers together was 0.352 and significant at 5 per cent and the MVP to MFC ratio was 1.72.The regression coefficients of plant protection chemicals and machine labour were not significant and their MVP to MFC ratio was 1.61 and -0.0251 respectively. The regression coefficient of human labour was 0.078 and significant at 1 per cent and the ratio was 0.02. The R^2 value was 0.77. The return to scale of this model was 0.62. The results of regression analysis in the production of tissue culture banana indicated that, regression co-efficient of plantlets was 0.091 and significant at 5 per cent level and the MVP to MFC ratio was 1.74. The regression coefficients of FYM and fertilizers together was (- 0.04) non-significant and the MVP to MFC ratio was -3.47 and the regression coefficients of plant protection chemicals, human labour and machine labour were significant at 1 per cent level. And their respective MVP to MFC ratios was 2.19, 0.96 and 0.92 respectively.

The R^2 value was 0.46. The return to scale of this model was 0.37. All technical, allocative and economic efficiencies were higher in case of sucker banana compared to tissue culture banana. Opinion survey of cultivators on different aspects of production of sucker and tissue culture banana identified that, non-availability of labour in sufficient quantity and at correct time, shortage of irrigation water in summer, destruction of plants due to high wind in the months of May, June and July months and inadequate supply of planting material were observed as major problems in both tissue culture and sucker banana. Lack of knowledge about identifying the pests, diseases and knowledge of plant protection and lack of knowledge about tissue culture banana production were major problem identified in banana production.

The problems faced by the farmers in marketing of banana were fluctuation in market prices of the produce, lack of market for banana nearer (distant market) to farm or village and non-availability of proper storage facilities and lack of grading and packaging. High cost of planting material, high cost of pesticides and labours were the major financial constraints identified in tissue culture banana.

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